SOUTHERN MIDLANDS COUNCIL

Southern Tasmanian COUNCILS AUTHORITY

Climate Change Information for Decision Making

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THE PURPOSE OF THIS DOCUMENT

This document summarises key climate indices useful to operational council staff. The climate indices were selected in direct consultation with council personnel and reflect the operational, tactical and strategic climate information needs for decision makers within all of the local councils of southern Tasmania.

This document expands upon previously produced *local profiles* and has been developed to support decision making across Southern Midlands's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Southern Midlands has been developed using outputs from the *Climate Futures for Tasmania Project* and the *Climate Futures Australasian Projections 2019 data archive*, developed by the University of Tasmania's Climate Futures Programme.

All values are based on the projections generated by the Climate Futures Programme, using previously published results. Descriptive documentation and supporting reports can be found here: http://climatefutures.org.au. This document is to be reviewed and updated when more up-to-date information becomes available, or at 5-yearly intervals. It should be considered in conjunction with Southern Midlands's policies and strategies, alongside technical and industry standards.

Values given are the multi-model mean from an ensemble of six downscaled global climate models based on the *business as usual* high emissions scenario RCP8.5 (the scenario human society is currenty most closely following). Averaging across the ensemble smooths out the inter-annual variability, revealing the forced climate response. For most variables, the range between climate models is not large relative to the percent change projected into the future.

In order to capture the regional variability, the data were separated into *cool* ($< 25^{th}$ percentile), *average* (between the 25^{th} and 75^{th} percentile) or *warm* ($> 75^{th}$ percentile) grid cells, based on average temperature during the baseline period, 1961–1990. These three groups of values were then analysed and presented separately. This provides councils with greater utility when mangaing a diverse landscape (NB: municiaplities with small spatial extents have limited differences captured across the municipality at $10km^2$ resolution). It is the responsibility of the user to determine which values may be most appropriate for a given application. For example, if building a road over Vinces Saddle, it would be more useful to apply values from the cooler table, whereas for estimating future high-intensity rainfall within Kingston CBD, values from the warmer table would be more appropriate.

CURRENT CLIMATE AND RECENT TRENDS

All Tasmanian municipalities have a temperate, maritime climate with relatively mild winters at low elevations, transitioning towards warm alpine winters at higher elevations. Long-term average temperatures have risen in the decades since the 1950s at a rate of up to 0.1 °C per decade, with this rate expected to increase from 2020 onwards.

Despite covering small geographic areas all municipalities experience marked rainfall gradients, with average annual rainfall from about 600 mm per year at lower elevations and about 1500 mm per year at higher elevations. There has been a decline in average annual rainfall since the mid 1970s, and this decline has been strongest in autumn and enhanced over higher elevation regions.

EXTREME EVENTS

The changes in climate that are most likely to impact upon the each municipality's infrastructure, roads, the local community and the environment are an increase in intensity of extreme events. Potential impacts by 2100 are as follows (following the *business as usual* high emissions scenario RCP8.5):

- Increased evaporation and longer dry periods coupled with more extreme temperatures are likely to enhance the occurrence and intensity of bushfires.
- The frequency of extremely hot days (> 40°C) is projected to increase. Heat wave frequency is projected to remain stable, but will increase in intensity (warmer days and nights).
- The Annual Exceedance Probability (AEP) is a measure of the rarity of an event. Rainfall AEPs are expressed as the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. Heavier rainfall events are expected within a warmer climate. High daily runoff events are likely to increase, including those that may lead to erosion or flooding.
- Inundation along all coastal frontage will increase due to sea level rise. This means the coastal indunation AEP values for all probability events will increase in intensity. The current 100-year coastal inundation event may become a 50-year event by 2030, and a 5-year event by 2090.

Table 1: **Southern Midlands local government area: *Cool subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	9.5	10	0.5	5.3	10.6	1.1	11.1	11.2	1.7	18.1	12	2.5	26	12.6	3.1	32.3
Average daily maximum temperature (°C)	14.6	15.1	0.5	3.5	15.8	1.1	7.7	16.4	1.8	12.4	17.2	2.6	17.9	17.8	3.2	21.9
Average daily minimum temperature (°C)	4.4	4.9	0.5	11.1	5.4	1	22.4	6.1	1.6	37	6.8	2.3	52.9	7.4	3	66.9
Hottest daily temperature of the year (°C)	33.7	34.4	0.7	2.1	35.1	1.4	4.1	36.1	2.4	7.2	36.6	2.9	8.5	37.2	3.5	10.3
Temperature of warmest days [99^{th} percentile] (°C)	29.1	29.9	0.7	2.5	30.6	1.4	4.9	31.5	2.3	7.9	32.4	3.3	11.2	32.7	3.6	12.2
Temperature of warmest nights [99^{th} percentile] (°C)	14	14.5	0.4	3.1	14.9	0.9	6.3	15.4	1.3	9.5	16.1	2	14.5	16.4	2.3	16.5
Temperature of coldest nights [1^{st} percentile] (°C)	-4.1	-3.7	0.4	9.9	-3.3	0.9	20.7	-2.7	1.4	34.5	-1.9	2.2	53.3	-1.2	2.9	70.7
Average annual frost risk days (<2°C)	104	89	-15	-14.3	77	-28	-26.4	61	-44	-41.8	45	-59	-56.9	33	-71	-68.1
Average annual freeze risk days (<0°C)	52	41	-10	-19.5	34	-18	-34.4	24	-27	-53.2	16	-36	-69.1	10	-41	-80
Average annual summer days (>25°C)	14	15	2	12.2	18	4	31.9	21	8	56.7	25	12	85.1	28	15	108
Average annual hot days (>30°C)	3	4	1	26.2	5	2	63.3	7	4	128.2	8	6	190.7	10	7	250.4
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	46200	56000	9800	21.2	68200	22000	47.6	86900	40700	88.1	114600	68400	148.1	144900	98700	213.6
Average annual evaporation (mm)	905	919	14	1.5	960	54	6	1009	103	11.4	1061	156	17.2	1136	231	25.5
Average annual rainfall (mm)	606	587	-20	-3.2	570	-36	-6	570	-37	-6.1	555	-51	-8.4	590	-17	-2.8
Seasonal rainfall - Winter (mm)	179	169	-10	-5.6	162	-17	-9.4	168	-10	-5.8	169	-10	-5.4	183	4	2.4
Seasonal rainfall - Spring (mm)	149	145	-3	-2.2	136	-12	-8.3	132	-16	-11	134	-14	-9.6	122	-27	-18.1
Seasonal rainfall - Summer (mm)	137	134	-3	-2.1	145	8	5.9	138	1	1.1	132	-5	-3.5	144	8	5.6
Seasonal rainfall - Autumn (mm)	152	153	1	0.4	140	-12	-7.7	144	-8	-5.3	133	-19	-12.7	148	-4	-2.4
Annual maximum daily rainfall (mm)	71	72	1	1.4	87	16	21.9	78	7	10.4	78	7	10.4	89	18	25.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	120	123	3	2.6	127	7	5.4	131	11	8.9	136	15	12.7	139	19	15.8
Rainfall Extreme - 24hr 5% AEP (mm)[a]	138	142	4	2.6	146	7	5.4	150	12	8.9	156	18	12.7	160	22	15.8
Rainfall Extreme - 24hr 1% AEP (mm)[a]	176	181	5	2.6	186	10	5.4	192	16	8.9	199	22	12.7	204	28	15.8
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	195	200	5	2.6	205	11	5.4	212	17	8.9	219	25	12.7	225	31	15.8
Rainfall Extreme - 48hr 10% AEP (mm)[a]	156	160	4	2.6	165	8	5.4	170	14	8.9	176	20	12.7	181	25	15.8
Rainfall Extreme - 48hr 5% AEP (mm)[a]	179	183	5	2.6	188	10	5.4	194	16	8.9	201	23	12.7	207	28	15.8
Rainfall Extreme - 48hr 1% AEP (mm)[a]	230	235	6	2.6	242	12	5.4	250	20	8.9	259	29	12.7	266	36	15.8
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	253	260	7	2.6	267	14	5.4	275	22	8.9	285	32	12.7	293	40	15.8
Average annual cummulative Forest Fire Danger Index	1464	1514	50	3.4	1671	208	14.2	1782	318	21.7	1951	487	33.3	2072	608	41.6
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 2: **Southern Midlands local government area:** ***Average subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	10.4	10.8	0.5	4.7	11.4	1	9.8	12	1.7	16.2	12.8	2.4	23.3	13.4	3	29.1
Average daily maximum temperature (°C)	15.5	16	0.5	3.1	16.5	1	6.8	17.2	1.7	11.2	18	2.5	16.2	18.6	3.1	20
Average daily minimum temperature (°C)	5.2	5.7	0.5	9.3	6.2	1	18.7	6.9	1.6	31	7.6	2.3	44.4	8.2	2.9	56.2
Hottest daily temperature of the year (°C)	34.7	35.5	0.7	2.2	36.3	1.6	4.6	37.4	2.7	7.7	37.8	3.1	9	38.7	4	11.4
Temperature of warmest days [99^{th} percentile] (°C)	29.5	30.2	0.7	2.2	30.8	1.3	4.3	31.8	2.2	7.6	32.8	3.2	10.9	33	3.5	11.8
Temperature of warmest nights [99^{th} percentile] (°C)	14.7	15.1	0.5	3.1	15.5	0.9	5.9	16	1.4	9.3	16.8	2.1	14.3	17.1	2.4	16.4
Temperature of coldest nights [1^{st} percentile] (°C)	-3.4	-3.1	0.3	10.1	-2.7	0.8	22.1	-2.1	1.3	38.5	-1.4	2.1	59.8	-0.6	2.8	81.2
Average annual frost risk days (<2°C)	82	69	-13	-15.7	58	-23	-28.6	45	-37	-45.2	32	-50	-60.9	23	-59	-72.5
Average annual freeze risk days (<0°C)	37	29	-8	-20.7	24	-13	-36.3	16	-21	-56.2	10	-27	-72.5	6	-31	-82.6
Average annual summer days (>25°C)	15	16	2	11.4	19	4	29.3	23	8	53.5	27	12	82.6	30	16	105.6
Average annual hot days (>30°C)	3	4	1	23.2	5	2	55.9	7	4	116.4	9	6	174.8	11	7	228.2
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	63000	76300	13300	21.1	92500	29500	46.8	118000	55000	87.3	155600	92600	147	196600	133600	212.1
Average annual evaporation (mm)	960	972	12	1.3	1010	50	5.2	1060	100	10.4	1114	154	16	1192	232	24.2
Average annual rainfall (mm)	581	561	-20	-3.5	553	-29	-4.9	549	-33	-5.6	530	-51	-8.8	557	-25	-4.2
Seasonal rainfall - Winter (mm)	164	154	-10	-6.2	149	-15	-9.4	154	-10	-6.3	152	-12	-7.2	163	-1	-0.5
Seasonal rainfall - Spring (mm)	142	137	-5	-3.5	130	-12	-8.5	126	-17	-11.8	126	-16	-11.1	112	-31	-21.5
Seasonal rainfall - Summer (mm)	137	135	-3	-1.9	148	10	7.4	141	4	2.9	134	-3	-2.5	146	9	6.2
Seasonal rainfall - Autumn (mm)	147	148	1	1	139	-8	-5.4	141	-6	-4.2	129	-17	-11.8	143	-4	-2.5
Annual maximum daily rainfall (mm)	71	72	1	1.4	87	16	21.9	78	7	10.4	78	7	10.4	89	18	25.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	120	123	3	2.5	127	6	5.2	131	10	8.6	135	15	12.4	139	19	15.5
Rainfall Extreme - 24hr 5% AEP (mm)[a]	138	142	3	2.5	145	7	5.2	150	12	8.6	155	17	12.4	159	21	15.5
Rainfall Extreme - 24hr 1% AEP (mm)[a]	177	181	4	2.5	186	9	5.2	192	15	8.6	198	22	12.4	204	27	15.5
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	195	200	5	2.5	205	10	5.2	211	17	8.6	219	24	12.4	225	30	15.5
Rainfall Extreme - 48hr 10% AEP (mm)[a]	157	160	4	2.5	165	8	5.2	170	13	8.6	176	19	12.4	181	24	15.5
Rainfall Extreme - 48hr 5% AEP (mm)[a]	179	183	4	2.5	188	9	5.2	194	15	8.6	201	22	12.4	206	28	15.5
Rainfall Extreme - 48hr 1% AEP (mm)[a]	230	235	6	2.5	242	12	5.2	249	20	8.6	258	28	12.4	265	36	15.5
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	253	260	6	2.5	266	13	5.2	275	22	8.6	285	31	12.4	292	39	15.5
Average annual cummulative Forest Fire Danger Index	1710	1760	50	2.9	1902	192	11.2	2037	327	19.1	2233	523	30.6	2389	679	39.7
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated* 14^{th} *May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 3: **Southern Midlands local government area: *Warm subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	11.2	11.7	0.5	4.3	12.2	1	9	12.9	1.7	15	13.6	2.4	21.6	14.3	3	27
Average daily maximum temperature (°C)	16.5	17	0.5	3	17.6	1.1	6.4	18.3	1.8	10.7	19.1	2.5	15.4	19.7	3.1	19
Average daily minimum temperature (°C)	5.9	6.4	0.5	8.2	6.9	1	16.3	7.5	1.6	27.1	8.2	2.3	38.9	8.8	2.9	49.3
Hottest daily temperature of the year (°C)	35.7	36.5	0.8	2.2	37.4	1.7	4.8	38.6	2.9	8	39	3.3	9.2	39.9	4.2	11.8
Temperature of warmest days [99^{th} percentile] (°C)	30.8	31.5	0.7	2.2	32.1	1.3	4.1	33.1	2.3	7.3	34.1	3.3	10.7	34.4	3.6	11.6
Temperature of warmest nights [99^{th} percentile] (°C)	15.3	15.8	0.5	3.1	16.2	0.8	5.5	16.7	1.4	9	17.4	2.1	13.8	17.8	2.5	16.1
Temperature of coldest nights [1^{st} percentile] (°C)	-3	-2.7	0.3	10.7	-2.3	0.7	22.9	-1.8	1.3	41.7	-1.1	2	64.8	-0.3	2.7	90.2
Average annual frost risk days (<2°C)	66	55	-11	-17.4	46	-20	-30	35	-31	-47.5	25	-41	-62.6	17	-49	-74.1
Average annual freeze risk days (<0°C)	28	22	-6	-21.1	18	-10	-36.5	12	-16	-56.1	8	-20	-71.6	5	-23	-81.9
Average annual summer days (>25°C)	20	23	2	10.8	26	5	25.9	30	10	47	35	15	71.4	39	18	90.1
Average annual hot days (>30°C)	5	6	1	20.2	8	2	46.7	10	5	97.4	13	7	139.5	15	10	186.6
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	81700	98600	16900	20.7	119200	37500	45.9	152000	70300	86	199900	118200	144.7	253200	171500	209.9
Average annual evaporation (mm)	1021	1031	11	1	1071	50	4.9	1124	103	10.1	1178	158	15.5	1260	240	23.5
Average annual rainfall (mm)	506	492	-13	-2.7	491	-15	-3	486	-20	-3.9	474	-32	-6.3	502	-4	-0.9
Seasonal rainfall - Winter (mm)	143	136	-7	-4.6	132	-11	-7.5	136	-7	-5.2	136	-7	-4.9	146	3	2.1
Seasonal rainfall - Spring (mm)	125	122	-3	-2.5	117	-8	-6.5	113	-12	-9.7	114	-11	-8.7	101	-23	-18.8
Seasonal rainfall - Summer (mm)	120	118	-3	-2.3	132	12	9.9	125	4	3.6	119	-1	-0.7	131	11	9.3
Seasonal rainfall - Autumn (mm)	126	128	2	1.8	121	-5	-4	125	-1	-1.2	116	-10	-8.2	130	4	2.8
Annual maximum daily rainfall (mm)	71	72	1	1.4	87	16	21.9	78	7	10.4	78	7	10.4	89	18	25.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	120	123	3	2.5	127	6	5.2	131	10	8.6	135	15	12.4	139	19	15.5
Rainfall Extreme - 24hr 5% AEP (mm)[a]	138	142	3	2.5	145	7	5.2	150	12	8.6	155	17	12.4	160	21	15.5
Rainfall Extreme - 24hr 1% AEP (mm)[a]	177	181	4	2.5	186	9	5.2	192	15	8.6	199	22	12.4	204	27	15.5
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	195	200	5	2.5	205	10	5.2	211	17	8.6	219	24	12.4	225	30	15.5
Rainfall Extreme - 48hr 10% AEP (mm)[a]	157	160	4	2.5	165	8	5.2	170	14	8.6	176	19	12.4	181	24	15.5
Rainfall Extreme - 48hr 5% AEP (mm)[a]	179	183	4	2.5	188	9	5.2	194	15	8.6	201	22	12.4	207	28	15.5
Rainfall Extreme - 48hr 1% AEP (mm)[a]	230	235	6	2.5	242	12	5.2	250	20	8.6	258	28	12.4	265	36	15.5
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	253	260	6	2.5	266	13	5.2	275	22	8.6	285	31	12.4	293	39	15.5
Average annual cummulative Forest Fire Danger Index	1888	1930	42	2.2	2075	187	9.9	2222	334	17.7	2411	523	27.7	2560	672	35.6
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Climate Change Information for Decision Making - Southern Midlands

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